Amendments to the Claims:

Please amend claims 1, 26, 37, 39, 43, and 46 as follows.

1. (currently amended) An ion storage system comprising:

a) an ion trap that defines a volume for storing a plurality of ions;

b) a radio frequency (RF) generator that is electromagnetically coupled to the volume defined by the ion trap, the RF generator generating ~~an~~ RF electrical field that stores the plurality of ions in the ion trap;

c) a switching device that terminates the RF electrical field, the termination of the RF electrical field ejecting the plurality of ions from the ion trap for detection; and

d) an ion detector that is substantially synchronized to the switching device, the ion detector detecting at least a portion of the plurality of ions that are ejected from the ion trap.

2. (original) The ion storage system of claim 1 further comprising an ion source that generates the plurality of ions.

3. (original) The ion storage system of claim 1 further comprising an ion source that provides the plurality of ions to the ion trap.

4. (original) The ion storage system of claim 2 wherein the ion source generates the plurality of ions in the volume defined by the ion trap.

5. (original) The ion storage system of claim 2 wherein the ion source comprises an electron source.

6. (original) The ion storage system of claim 5 wherein the electron source comprises a thermionic emission filament.

7. (original) The ion storage system of claim 2 wherein the ion detector is

synchronized to the generation of the ions by the ion source.

8. (original) The ion storage system of claim 2 further comprising a pulsed gas injector that provides neutral gas molecules.

9. (original) The ion storage system of claim 2 further comprising a pulsed gas injector that provides neutral gas atoms to the ion source.

10. (original) The ion storage system of claim 8 wherein the pulsed gas injector provides analyte gas molecules or atoms for mass analysis.

11. (original) The ion storage system of claim 1 wherein the ion trap comprises a substantially cylindrically shaped volume.

12. (original) The ion storage system of claim 1 wherein the ion trap comprises a volume having substantially straight walls.

13. (original) The ion storage system of claim 1 wherein the ion trap comprises a volume having substantially curved walls.

14. (original) The ion storage system of claim 13 wherein the curved walls comprise substantially hyperbolic shaped walls.

15. (original) The ion storage system of claim 1 wherein the switching device comprises an electronic switching device.

16. (original) The ion storage system of claim 1 wherein the switching device comprises a mechanical switching device.

17. (original) The ion storage system of claim 1 wherein the switching device causes a short circuit condition that terminates the RF electrical field.

18. (original) The ion storage system of claim 1 wherein the switching device terminates the RF electrical field within a time period that is substantially equal to or less than one cycle of the RF electrical field.

19. (original) The ion storage system of claim 1 wherein the switching device is substantially synchronized with a predetermined phase of the RF electrical field.

20. (original) The ion storage system of claim 1 wherein the ion detector is substantially synchronized with a predetermined phase of the RF electrical field.

21. (original) The ion storage system of claim 1 wherein the ion detector is substantially synchronized to interrupting an operation of a vacuum pump that evacuates the volume defined by the ion trap.

22. (original) The ion storage system of claim 1 further comprising a clock that synchronizes the switching device.

23. (original) The ion storage system of claim 22 wherein the clock synchronizes the switching device to the ion detector.

24. (original) The ion storage system of claim 22 wherein the clock determines a time at which the switching device terminates the RF electrical field.

25. (original) The ion storage system of claim 1 wherein the ion detector comprises an electron multiplier.

26. (currently amended) An ion storage system comprising:

a) an ion source that generates a plurality of ions;

b) an ion trap that defines a volume for storing the plurality of ions;

c) a radio frequency (RF) generator that is electromagnetically coupled to the volume defined by the ion trap, the RF generator generating a RF electrical field that stores the plurality of ions in the ion trap;

d) a switching device that terminates the RF electrical field, the termination of the RF electrical field ejecting the plurality of ions from the ion trap <u>for detection</u>;

e) an ion detector that detects at least a portion of the plurality of ions that are ejected from the ion trap; and

f) a clock that is electrically connected to at least two of the ion source, RF generator, the switching device, and the ion detector, the clock substantially synchronizing the at least two of the ion source, the RF generator, the switching device, and the ion detector.

27. (original) The ion storage system of claim 26 wherein the ion source generates the plurality of ions in the ion trap.

28. (original) The ion storage system of claim 26 wherein the ion source comprises an electron source and a pulsed gas source.

29. (original) The ion storage system of claim 26 wherein the ion trap comprises a substantially cylindrically shaped volume.

30. (original) The ion storage system of claim 26 wherein the ion trap comprises a volume having substantially straight walls.

31. (original) The ion storage system of claim 26 wherein the ion trap comprises a volume having substantially hyperbolic walls.

32. (original) The ion storage system of claim 26 wherein the switching device comprises an electronic switching device.

33. (original) The ion storage system of claim 26 wherein the switching device causes a short circuit condition that terminates the RF electrical field.

34. (original) The ion storage system of claim 26 wherein the switching device terminates the RF electrical field within a time period that is substantially equal to or less than one cycle of the RF electrical field.

35. (original) The ion storage system of claim 26 wherein the ion detector comprises an electron multiplier.

36. (original) The ion storage system of claim 26 wherein the ion detector is substantially synchronized to interrupting an operation of a vacuum pump that evacuates the volume defined by the ion trap.

37. (currently amended) An ion storage system comprising:

a) means for generating a plurality of ions from neutral gas molecules or atoms;

b) means for establishing a radio frequency (RF) electrical field proximate to the plurality of ions, thereby trapping the plurality of ions in a volume;

c) means for terminating the RF electrical field, thereby ejecting the plurality of ions from the volume for detection; and

d) means for detecting at least a portion of the plurality of ions ejected from the volume at a predetermined time after terminating the RF electrical field.

38. (original) The ion storage system of claim 37 wherein the means for terminating the RF electrical field is substantially synchronized to at least one of the means for generating the plurality of ions, means for establishing the RF electrical field, and means for detecting the at least a portion of the plurality of ions ejected.

39. (currently amended) A method for detecting ions, the method comprising:

a) establishing a radio frequency (RF) electrical field proximate to a plurality of ions, thereby trapping the plurality of ions in a volume;

b) terminating the RF electrical field, thereby ejecting the plurality of ions from the volume for detection; and

c) detecting at least a portion of the plurality of ions ejected from the volume at a predetermined time after terminating the RF electrical field.

40. (original) The method of claim 39 further comprising generating ions from neutral gas molecules or atoms.

41. (original) The method of claim 39 wherein a time at which the RF electrical field is terminated is substantially synchronized to at least one of a predetermined phase of the RF electrical field and a time of detecting at least a portion of the plurality of ions ejected from the volume.

42. (original) The method of claim 39 wherein the terminating the RF electrical field is completed substantially within one cycle of the RF electrical field.

43. (currently amended) The method of claim 39 wherein the detecting ~~the~~ at least a the portion of the plurality of ions ejected from the volume occurs at a predetermined time after terminating the RF electrical field.

44. (original) The method of claim 39 wherein the detecting the at least a portion of the ions ejected from the ion trap occurs at a predetermined time after terminating the RF electrical field that maximizes a signal-to-noise ratio of an electrical signal related to the detection of the at least a portion of the plurality of ions.

45. (original) The method of claim 39 wherein the terminating the RF electrical field comprises establishing a short-circuit condition that terminates the RF electrical field.

46. (currently amended) A leak detector comprising:

a) an ion source that receives a tracer gas and that generates a plurality of ions of the tracer gas;

b) an ion trap that defines a volume for storing the plurality of ions of tracer gas;

c) a radio frequency (RF) generator that is electromagnetically coupled to the volume defined by the ion trap, the RF generator generating a RF

electrical field that stores the plurality of ions of the tracer gas in the ion trap;

d) a switching device that terminates the RF electrical field, the termination of the RF electrical field ejecting the plurality of ions from the ion trap for detection;

e) an ion detector that detects at least a portion of the plurality of ions that are ejected from the ion trap; and

f) a clock that is electrically connected to at least two of the ion source, RF generator, the switching device, and the ion detector, the clock substantially synchronizing the at least two of the ion source, the RF generator, the switching device, and the ion detector.